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Private Expenditures for Children in Austria - Variations in Results applying different Models

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1. Introduction

Aside from income and prices, size is the most prominent determinant of a household's consumption expenditures. Frequently this fact is used to estimate the expenditures due to additional persons living in a household; in most instances the expenditures for children are at the centre of interest. The reasons for this specific focus are manifold and range from issues of equity in taxation of households of different composition to the determination of child allowances in cases of divorce or separation.

Most analyses of this kind focus on the empirical knowledge of amounts of expenditures or equivalence scales in relation to a household's income. Economists have tried to estimate what are, loosely termed, the cost of children for many countries, with consumer surveys forming the most commonly used data base[1].

Unfortunately, econometric identification prevents easy and straightforward estimation. At the core of all empirical analyses is a multitude of attempts to solve the identification problem: In cross-section consumer surveys the identification problem results from the difficulty of establishing comparable levels of welfare (utility) and the expenditures simultaneously. The central question is: How much more income should a family with children have at its disposal in relation to a comparable household without children to achieve the same level of welfare?[2]

The object of this paper is the estimation of equivalence scales and expenditures for children. We apply different commonly used models (sketched in section 2) on recent Austrian data, briefly described in section 3, in order to show the range of estimates resulting from different approaches (section 4), and to compare them with previous studies for Austria

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[1] We prefer the term 'private expenditures for children' to 'cost of children', since the latter consist of expenditures (or direct cost) and the (indirect) cost of foregone earnings, usually by the mothers. These opportunity costs of children have also been part of the Austrian study on which this paper is based; cf. *GUGER et al.* (2003), and *LUTZ* (2003).

[2] Normative methods of determining the 'cost of children' will not be considered in this paper.

and estimates for other countries based on similar methodologies (section 5). Conclusions and policy implications round off the analysis (section 6).

2. Some Common Models for the Estimation of Private Expenditures on Children

Equivalence scales for households of different composition indicate the ratios of incomes required for different households to be at the same level of welfare (income equivalence scales). We estimate equivalence scales for different groups of commodities, so called commodity specific equivalence scales. These scales allow the computation of expenditures for children for different income levels.

Equivalence scales should fulfil certain properties, viz. they should

- be derived from or at least be compatible with (utility) theory;
- utilize as much information as possible contained in the data;
- be differentiated by age, and number of children;
- be 'plausible' in themselves and in national and international comparisons.

Starting from a utility maximizing household we find the demand to depend on household income with prices being constant in cross-sections. Using the resulting Engel functions we are faced with the fundamental problem of simultaneously establishing the relationship between expenditures and income as well as the equivalency of incomes of households of different sizes. This requires additional assumptions, restrictions and/or information.

Single equation models establish equivalency in different ways: According to *ENGEL* (1895) the welfare levels of two households of different size (and composition) are equivalent if their income shares spent on food and beverages are equal. The modified Engel approach expands to the income share of necessities, usually the sum of expenditures on food and beverages, housing, and clothing (*BINH - WHITEFORD,* 1990; *STRYCK*, 1997; *DEATON*, 1998). Engel functions are estimated, with expenditure shares as the dependent variable, for a 'reference' household (e. g. two adults) and the household 'type' whose income equivalency is to be established (e. g. two adults plus two children). The income share of food expenditures of a reference household is then used to determine, via the Engel function, the income level of the household 'type' at which this household's share on food expenditures is the same as the 'reference' household's. The ratio of these two incomes is the income equivalence scale.

BUCHEGGER (1986A, 1986B), following *PRAIS - HOUTHAKKER* (1971), suggests an iterative procedure, simultaneously determining expenditure specific scales and the income scale. He utilizes the property that the latter is the weighted sum of the former, using the 'reference' household's income shares of these expenditures as weights. Engel functions for groups of commodities (usually around 5 to 10) are estimated for both households. Starting with a 'plausible' income equivalence scale the expenditure specific scales are computed. Their weighted sum is then used for a new round of estimations. This process is continued until two consecutive income equivalence scales differ by less than a pre-set convergence criteria.

Another possibility is to apply the idea of satiation. Household equivalency is derived from comparing the expenditure levels on a specific good (usually a necessity, such as a composite of expenditures on food and non-alcoholic beverages) at which satiation is reached for households of different sizes employing an appropriate functional form of the Engel curve. The resulting expenditure specific equivalence scale can then be used for identification in the estimation of the income equivalence scale.

Following *ROTHBARTH* (1943) two different households are at the same level of welfare if they spend the same amount on goods exclusively consumed by adults, so-called 'adult goods' such as (a composite of) adult clothing, alcohol, tobacco, etc. (*TURCHI*, 1984; *DEATON*, 1998). Engel functions are estimated for e. g. a composite 'adult good' for both households. The two 'equivalent' income levels are then computed for expenditures on this 'adult good' for both households using the estimated Engel functions.

An alternative to the single equation approach are systems of demand functions. They allow the explicit computation of equal levels of utility for differently sized households. As an example, the Linear Expenditure System (LES) would be extended by the inclusion of a demographic variable. Demographic differences could either influence the minimum consumption or could affect both the minimum consumption and the parameter determining the consumption out of the 'supernumerary income' (Extended Linear Expenditure System - ELES; *KAKWANI,* 1980; *STRYCK,* 1997). Expenditure specific and income equivalence scales are computed from either the different levels of the minimum consumptions or from the different levels of the overall consumption yielding identical utility levels for both groups of households.

Single equation methods are more flexible in the specification of the functional form, systems approaches - while having a firm rooting in theory (additivity, substitutability, etc.) - are more restrictive in this respect and are also more sensitive to the quality of the data (*SCHNEIDER - WÜGER,* 1988). In the following analysis all of the methods briefly outlined are applied to the most recent consumer survey for Austria. The results of the various models are compared with the results of other studies.

3. The Data

3.1 The Austrian Consumer Survey 1999/2000

The data are from the Austrian Consumer Survey which was carried out by the Austrian Statistical Office ('Statistik Austria') between November 1999 and October 2000, based on a sub-sample of the (quarterly) Austrian Microcensus (*KRONSTEINER*, 2001). Households were asked to record in detail expenditures for a period of two weeks including consumption from own production (e.g. fruits and vegetables). Statistik Austria converted these data into monthly expenditures, proportionately to the days of data collection. Information on expenditures with low frequency was gathered by means of a retrospective questionnaire covering the previous 12 months; these entered into the respective categories with 1/12 of the figures quoted. Incomes were asked in great detail in analogy to the European Community Household Panel (17 categories by type and source). In total, 7,098 household records resulted from this survey.

Plausibility tests indicated problems for certain expenditure categories, mainly due to recording frequency or to bulk purchases. Car purchases would be an example of the former, the purchase of heating material (mainly oil or gas) could serve as an illustration of the latter (*KLETZAN et al.*, 2001). Since we used individual household data we had to adjust for implausible values. This is particularly important since we are employing sub-samples that should be as homogeneous as possible - with the exception of household size - thus allowing us to isolate the effects of children on consumption expenditures.

In several categories expenditures for children were recorded separately. Although these would not yield meaningful overall equivalence scales we could derive adult expenditures for some categories to be used in the analyses à la *ROTHBARTH* (cf. section 2 above).

3.2 Sample Selection

In order to ensure homogeneity of the households to be compared a sub-sample of the consumer survey was formed limiting our analyses to the following households:

- The head of the household had to participate in the labour market and be less than 60 years old. This led to the exclusion of pensioners and other households with elderly heads whose expenditure structure would differ from 'younger' households with or without children.
- There had to be no more than two adults per household. The maximum number used in households with one adult was three (i. e. two children), in households with two adults the allowed maximum was five (three children).
- To avoid extreme fluctuations only households with average propensities to consume between .25 and 2.11 are included. This can be seen as the elimination of outliers.

- Children are defined as persons up to a maximum age of 18.[3]

This left us with a sub-sample of 3,652 households or 51.5% of the total number of households surveyed. Table 1 contains the summary statistics.

It should be noted that the APCs of the households with one adult and at least one child are all larger than one; this could be interpreted as an indicator of the strained financial situation of these households.

Table 1: Average monthly income and consumption average propensity to consume (APC) of the sub-sample, 1999/2000

	Number of cases	Income in €	Consumption in €	APC
One adult				
Single	559	1,593	1,591	0.999
One adult and one child	162	1,546	1,635	1.057
One adult and two children	68	1,746	1,966	1.126
Two adults				
Without child	862	2,835	2,594	0.915
Two adults and one child	732	2,957	2,777	0.939
Two adults and two children	956	2,915	2,886	0.990
Two adults and three children	313	3,245	3,156	0.973
Total	3,652	2,517	2,413	0.959

Source: Statistik Austria, Consumer Survey 1999/2000; own computations.

Consumption expenditures are aggregated into the following seven categories:

- Food, beverages, tobacco, restaurants
- Clothing and shoes
- Housing (incl. heating and lighting) and furnishings
- Personal hygiene and health
- Transportation (excl. purchases of cars!) and communication
- Education, leisure, and vacation
- Other

[3] The full results with an additional definition of children up to a maximum age of 26 can be found in *GUGER et al.* (2003); the data can be made available by the authors on request.

Since we are dealing with monthly data, seasonal influences have to be eliminated in order to achieve a homogeneous consumption structure. To reduce seasonality, households are ordered by the size of their income (within each group); then averages are formed across the four nearest households stemming from different months.[4]

In order to implement the *ROTHBARTH* method expenditures on the consumption of 'adult goods' are required. We use the information on expenditures for children in several expenditure items to generate this 'adult' consumption by deducting children's expenditures from the relevant total. We did this for the expenditure categories clothing and shoes, personal hygiene and health, and for education, leisure, and vacation.[5] This innovation renders more meaningful results compared to the usage of alcohol, tobacco and the like, which usually do not yield good estimates of the *ENGEL* functions and thus led to difficulties in applying the *ROTHBARTH* method.

4. Equivalence Scales for Austria

4.1 Results of the Estimation

4.1.1 ENGEL Approach

We expect the category food, beverages, tobacco, restaurants to be most reliable in terms of the recording of the data; therefore we used this category to implement the original *ENGEL* approach. For the modified *ENGEL* approach we added the categories of clothing and shoes as well as housing and furnishings. The results are presented in Table 2.

Our equivalence scales according to the modified *ENGEL* approach are only marginally smaller compared to the original *ENGEL* approach. This is in contrast to international studies with more pronounced differences (*STRYCK*, 1997). Remarkable (and perhaps questionable) is the increase in expenditures per child in relation to the expenditures of one adult with the number of children as measured by the consumption units. This implies that there are neither 'economies of scale' nor impoverishments due to budgetary constraints.

4.1.2 BUCHEGGER Procedure

The procedure suggested by *BUCHEGGER* allows for differences in the preferences between households with and without children. We only achieve convergence when we use

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[4] A full consideration of seasonality using 12 months-averages would have reduced the number of observations too much for meaningful regression analysis.

[5] These categories were selected since the directly recorded expenditures for children led to meaningful equivalence scales, roughly in line with the econometrically derived expenditure specific scales; cf. section 4.1.7 below.

income as the explanatory variable. Income seems to be more reliable due to the detailed recording compared to the more irregularly varying total expenditures[6].

The results of this procedure lead to similar results as the two *ENGEL* approaches with the exception of the single adult households. These (implausibly) high estimates - more than double in terms of consumption units compared to all other estimates - for households with one adult are probably due to the small number of observations.

For households with two adults we find with this procedure a decline of the consumption units for households with three children, indicating economies of scale and/or budgetary limitations moving from households with two to households with three children.

Table 2: Equivalence Scales and Consumption Units for Children[1] According to Different Methods

	ENGEL approach[2]	Modified Engel approach	*BUCHEGGER* procedure	Satiation	*ROTHBARTH* method	Extended Linear Expenditure System
			Equivalence Scales			
One adult						
One child	1.248	1.244	1.664	1.287	1.237	1.319
Two children	1.564	1.553	2.180	1.573	1.457	1.558
Two adults						
One child	1.182	1.177	1.172	1.180	1.142	1.142
Two children	1.399	1.386	1.393	1.359	1.275	1.232
Three children	1.658	1.636	1.544	1.539	1.408	1.351
			Consumption Units			
One adult						
One child	0.248	0.244	0.664	0.287	0.237	0.319
Two children	0.282	0.276	0.590	0.287	0.228	0.279
Two adults						
One child	0.364	0.353	0.344	0.359	0.283	0.284
Two children	0.399	0.386	0.393	0.359	0.275	0.232
Three children	0.438	0.424	0.362	0.359	0.272	0.234

[6] Due to e. g. bulk purchases in a specific month.

Source: Statistik Austria, Consumer Survey 1999/2000; own computations. - [1] Consumption units express the expenditures for one child in relation to one adult's expenditures. - [2] Averages of (very similar) results using income and total expenditures, resp., as independent variables.

4.1.3 Satiation

Using satiation the estimates are very similar to the *ENGEL* approach: somewhat higher for households with one adult, lower for two-adult-households, thus reducing the difference between the two groups of household types.[7]

4.1.4 ROTHBARTH Method

We find - as theoretically expected (*DEATON - MUELLBAUER*, 1986; *STRYCK*, 1997) - that the estimated scales are somewhat lower compared to those derived from the *ENGEL* approach. The small decline of the consumption units with the increase in the number of children should also be mentioned, pointing to slight scale economies and/or impoverishment.

4.1.5 Extended Linear Expenditure System

We also use the Extended Linear Expenditures System (ELES). Since in a demand system substitution is allowed for income equivalence scales are expected to be generally lower in comparison with the *ENGEL* approach. This is also the case for our estimation results confirming other international studies (*STRYCK*, 1997; *LANCASTER .-RAY*, 1998). Consumption units are higher for households with one adult compared to households with two adults and children, which conforms to a-priori notions. They decline for both household types with the number of children, implying pronounced economies of scale and/or budgetary constraints.

4.1.6 Compilation of the Estimates - an 'Austrian Equivalence Scale'

What could be a meaningful synthesis of these results to find the 'Austrian Equivalence Scale'? Or: Which scale should be recommended to the 'practitioner' applying these scales? To what degree can theory be of assistance?

The *ENGEL* approach forms an upper limit, the *ROTHBARTH* method a lower limit of the equivalence scales which may be illustrated by the following example (*DEATON - MUELLBAUER*, 1986; *STRYCK*, 1997). We assume there are only two goods (necessities and adult goods) and saving is excluded. Suppose that a child is born to a couple and their pre-child level of welfare should be maintained. In the *ROTHBARTH* case this household's

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[7] Methodologically the effects of economies of scale and/or budgetary constraints cannot be estimated with this approach.

income would be increased until the expenditures on ‘adult goods’ reach their pre-child level; this implies a higher share of necessities and thus a lower level of welfare in *ENGEL* sense. Therefore the *ENGEL* compensation would be more generous since income would have to be increased (by more) until equality of this share with its pre-child level is reached.

Estimations utilising systems of demand functions have a better theoretical foundation and thus solve the identification problem satisfactorily. On the other hand, they depend upon the specific utility function assumed and are more restrictive in their specification and more sensitive to data problems which may in turn reduce their ‘plausibility’.

Since theory appears to be of no real help in reaching an answer to the questions posed we have to fall back on our considerations at the outset of this paper (cf. section 2 above). In view of these postulates all of our estimates containing somewhat different specific information on the subject are candidates for an ‘Austrian Equivalence Scale’.[8] Thus, we advocate forming an average of the scales estimated by the different methods. The results are presented in Table 3.

Table 3: Computation of an ‘Austrian Equivalence Scale’

	Austrian Equivalence Scale	
	Equivalence Scale	Consumption Units
One adult		
One child	1.331	0.331
Two children	1.642	0.321
Two adults		
One child	1.165	0.330
Two children	1.338	0.338
Three children	1.518	0.345

Source: Statistik Austria, Consumer Survey 1999/2000; own computations.

4.1.7 Expenditure Specific Equivalence Scales

The *PRAIS - HOUTHAKKER* procedure as modified by *BUCHEGGER* also allows the estimation of expenditure specific equivalence scales (Table 4). There is remarkable variation among the expenditure categories, which can best be seen from the consumption units for children ranging from approximately 16% to 94%. The relations of these scales among each other correspond fairly well to a-priori expectations and thus form an implicit confirmation of the methodology used.[9]

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[8] In addition they are also monotonous in the sense that the equivalence scales increase with the number of children. They are also ‘plausible’ yielding consumption units for children less than unity.

[9] Due to the small number of observations for households with three children and households with one adult we had to limit ourselves to households with two adults and no more than two children.

Table 4: Expenditure Specific Equivalence Scales for Households Consisting of Two Adults Plus Child(ren)

	One child		Two children	
Expenditure category	Equivalence Scale	Consumption Unit	Equivalence Scale	Consumption Unit
Food, beverages, tobacco, restaurants	1.110	0.220	1.311	0.311
Clothing and shoes	1.440	0.880	1.940	0.940
Housing and furnishings	1.139	0.278	1.309	0.309
Personal hygiene and health	1.291	0.581	1.495	0.495
Transportation and communication	1.077	0.155	1.169	0.169
Education, leisure, and vacation	1.198	0.395	1.550	0.550
Other	1.243	0.486	1.367	0.367

Source: Statistik Austria, Consumer Survey 1999/2000; own computations.

4.1.8 Equivalence Scales by Age[10]

We subdivided our sub-sample further by the age of the child(ren), using the age of 10 years as a dividing line which was only possible for the two-adult households. This yielded a total of nine household types (one child up to 10 years, one child 11 to 18 years, two children up to 10 years, two children 11 to 18 years, two children with one up to 10 years and one 11 to 18 years, three children up to 10 years, three children 11 to 18 years, three children with two up to 10 years and one 11 to 18 years, three children with one up to 10 years and two 11 to 18 years).

We use the original *ENGEL* approach as well as its modified version.[11] Given the tendency of the first approach towards overestimation we form two averages of the results: one with equal weights, the other one by weighting the original and the modified approach at the ratio of one to three which roughly conforms to the ratio of the food consumption to 'necessities'.

In order to make the age specific estimates consistent with this Austrian scale we rescaled the age specific scales in such a way that their weighted average across household types by age group conforms to the income equivalence scale of the 'Austrian Equivalence Scale', with the weights being the numbers of households in each group.

The results are shown in Table 5, with a remarkable consistency and monotony of these estimates across ages within each household type. The age-specific differences in

[10] We could not differentiate the scales by gender due to lack of information in this dimension.

[11] Due to the relatively small number of households in each group we could no longer meaningfully form average households. Thus, the original household data were used for estimation, employing dummy variables to account for seasonality, and also correcting for outliers through appropriate methods (cf. *SCHEIDER - WÜGER*, 1998, and the literature quoted there).

equivalence scales and consumption units are in the 'simple average' version more pronounced.

Table 5: Equivalence Scales by Age for Households with Two Adults and Children Adjusted to the 'Austrian Equivalence Scale'

	Simple average[1]		Weighted Mean[2]	
	Equivalence Scale	Consumption Unit	Equivalence Scale	Consumption Unit
One child	*1.165*	*0.330*	*1.165*	*0.330*
Up to 10 years	1.120	0.240	1.136	0.273
11 to 18 years	1.209	0.418	1.194	0.388
Two children	*1.338*	*0.338*	*1.338*	*0.338*
Up to 10 years	1.238	0.238	1.272	0.272
One child up to 10 years and one child 11 to 18 years	1.334	0.334	1.336	0.336
11 to 18 years	1.442	0.442	1.406	0.406
Three children	*1.518*	*0.345*	*1.518*	*0.345*
Up to 10 years	1.351	0.234	1.408	0.272
Two children up to 10 years and one child 11 to 18 years	1.453	0.302	1.476	0.317
One child up to 10 years and two children 11 to 18 years	1.569	0.379	1.552	0.368
11 to 18 years	1.698	0.465	1.635	0.423

Source: Statistik Austria, Consumer Survey 1999/2000; own computations. - [1] Mean of original and modified *ENGEL* approach. - [2] Weighted mean of original and modified *ENGEL* approach at the ratio of 1 : 3.

5. National and International Comparison of Equivalence Scales

5.1 National Comparison

The only computations based on consumer surveys for Austria have been carried out by *BUCHEGGER* (1986A, 1986B). In Table 6 we compare these results with ours using the same methodology in both cases for households with two adults. They compare well with the exception of households with one child. The rather implausibly high results for this household type are explained in great detail in the references quoted above and are mainly founded in the specific situation of the Austrian housing market.

Table 6: Comparison with Previous Estimations for Austria, Household with two Adults

	WIFO-computation	*BUCHEGGER*
	Equivalence Scale	
One child	1.172	1.300
Two children	1.393	1.386
Three children	1.544	1.533
	Consumption Unit	
One child	0.344	0.600
Two children	0.393	0.386
Three children	0.362	0.355

Source: Statistik Austria, Consumer Survey 1999/2000; own computations; *BUCHEGGER* (1986A).

5.2 International Comparisons

First we compare our own estimates based on the modified *ENGEL* approach with the estimates for Germany, Switzerland and the USA by *STRYCK* (1997) based on the same methodology (Table 7). The robustness across different data sets strikes us as remarkable.

Table 7: International Comparison of Equivalence Scales for the Modified ENGEL Approach, Households with Two Adults

	Own estimates	*STRYCK* (1997)		
	Austria	Germany	Switzerland	USA
One child	1.17	1.19	1.21	1.20
Two children	1.37	1.37	1.39	1.37
Three children	1.60	1.55	1.56	1.52

Source: Own computations; *STRYCK* (1997).

LANCASTER - RAY (1998) estimated consumer equivalence scales for Australia using methodologies similar to ours (Table 8). Again the congruence is remarkable, with larger deviations only for households with three children in the cases of the two single-equations methods. This last aspect is similar to the results given in Table 7, except that there the Austrian figure is somewhat higher than the other countries', while in comparison to Australia the equivalence scales are somewhat lower.[12]

On all three comparisons shown our scales appear to be - grosso modo - in line with other studies thus fulfilling the postulate of plausibility in this respect.

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[12] These somewhat larger differences across countries and methods in the case of the three-children-households may be due to aspects ranging from smaller statistical bases to really differing relative welfare situations of this household type in various countries.

Table 8: Equivalence Scales for Australia (Lancaster-Ray) and Austria (Own Estimates), Households with Two Adults, Different Methods

Method	*ENGEL*		*ROTHBARTH*		Utility based approach	
	LANCASTER - RAY	Own estimates	*LANCASTER - RAY*	Own estimates	*LANCASTER - RAY*	Own estimates
Estimation basis	Food and beverages		Adult clothing		ELES[1]	
One child	1.21	1.18	1.15	1.16	1.12	1.14
Two children	1.45	1.40	1.32	1.30	1.24	1.23
Three children	1.75	1.66	1.52	1.44	1.36	1.35

Source: *LANCASTER - RAY*, 1998; own computations. - [1] Extended Linear Expenditures System.

6. Conclusion and Policy Implications

Theoretical models provide good guidance in trying to establish welfare equivalency between households of different size and composition. Yet, and not surprisingly, when these models are applied to data they yield different results. The ranges of the differences between these results are remarkably small. Confronting the results achieved for one data set - the Austrian Consumer Survey 1999/2000 - with previous Austrian and international results we find in many instances an almost surprising conformity despite some differences in methodology and in the consumption habits between countries and over time.

What could be a meaningful combination of different equivalence scales for a country to provide some guidance to practitioners, such as politicians deciding on issues of taxation or judges settling divorce disputes? Most estimates based on the most recent Austrian Consumer Survey turn out to be plausible and monotonous. Certain methods lead to over-, others to underestimation of equivalence scales. Since economic theory provides little guidance for the selection of a single result we decided on a simple unweighted average of these estimates as a plausible combination.[13] The resulting ‘Austrian Equivalence Scale’ could be applied to calculate the private expenditures on children in relation to a household’s income.

[13] Theory would have required a weighting by the inverse of the standard deviations of the estimates; given the closeness of our estimates these weighted averages differ only minimally from the simple averages.

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